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Annual Groundwater Monitoring Status Report for the Waste Area Group 5 for Fiscal Year 2003

September 2003

Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

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Idaho National Engineering and Environmental Laboratory
Idaho Completion Project
Idaho Falls, Idaho 83415

Prepared for the
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Assistant Secretary for Environmental Management
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Approved by

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ABSTRACT

This report presents the analytical and water level data collected in support of groundwater monitoring requirements at Waste Area Group 5 during Fiscal Year 2003. Sample collection and analysis requirements are defined in the *Groundwater Monitoring Plan for the Waste Area Group 5, Remedial Action,* and in the *Final Record of Decision for Power Burst Facility and Auxiliary Reactor Area*. The record of decision (signed February 2000) requires that surveillance monitoring of the groundwater underlying the Auxiliary Reactor Area and Power Burst Facility be conducted annually at least until the first five-year review due in FY-2005. At that time, the analytical data will be reviewed and a joint decision made with the Agencies as to what changes or revisions are required for the monitoring effort. This report summarizes the third year of post-record of decision monitoring data and historical data collected in partial fulfillment of the requirements delineated in the record of decision.

Analytical results are presented based on groundwater samples collected during the annual sampling effort conducted in October 2002 for Fiscal Year 2003. Tables presenting the analytical data are found in Appendix A. Tetrachloroethene was detected in samples from Wells ARA-MON-A-004 and PBF-MON-A-004 at concentrations of 5.1 µg/L and 5.4 µg/L respectively. Because lead concentrations in past sampling events exceeded regulatory limits, statistical trend analysis was conducted on the lead data. Although data are limited upon which to base any discernable trends, discussion of potentially developing trends in analytes is provided. In addition to the analytical data, groundwater level measurements were collected from 16 wells, and a groundwater map was generated (including newly obtained borehole deviation data). Current and historical results are presented in Section 3.3 of this document.

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TABLES

ACRONYMS

ARA	Auxiliary Reactor Area
CFA	Central Facilities Area
DOE-ID	U.S. Department of Energy Idaho Operations Office
EPA	U.S. Environmental Protection Agency
FY	fiscal year
INEEL	Idaho National Engineering and Environmental Laboratory
INEL	Idaho National Engineering Laboratory
MCL	maximum contaminant level
PBF	Power Burst Facility
RI/FS	Comprehensive Remedial Investigation Feasibility Study
ROD	Record of Decision
RPD	relative percent difference
SAM	Sample and Analysis Management
SPERT	Special Power Excursion Reactor Test
TAN	Test Area North
VOC	volatile organic compound
WAG	waste area group

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1. INTRODUCTION

Groundwater samples from the Snake River Plain Aquifer beneath the Waste Area Group (WAG) 5 were collected and analyzed in Fiscal Year (FY) 2003 in accordance with the requirements delineated in the *Groundwater Monitoring Plan for the Waste Area Group 5, Remedial Action* (DOE-ID 2000a), hereinafter referred to as the Groundwater Monitoring Plan. Groundwater monitoring is being conducted in partial satisfaction of the requirements set forth in the *Final Record of Decision for Power Burst Facility and Auxiliary Reactor Area* (DOE-ID 2000b), which was signed in February 2000. This FY 2003 report is the third annual report following the issuance of the Record of Decision (ROD).

As required in the ROD, groundwater monitoring is being conducted to reduce the uncertainties associated with previous sampling efforts and to provide trend data to assess the possibility that an unidentified source of lead contamination is affecting the aquifer. Specifically, samples have been collected to monitor the Snake River Plain Aquifer underlying the WAG 5 site to confirm that surface contaminants at the sites have not adversely affected the groundwater. Samples were collected for additional analyses to provide data in support of the five-year review for WAG 5 and the WAG 10, OU 10-08 Sitewide evaluation of the Snake River Plain Aquifer.

Waste Area Group 5 includes the Power Burst Facility (PBF) and the Auxiliary Reactor Area (ARA) located just to the east of the Central Facilities Area (CFA) in the southern end of the Idaho National Engineering and Environmental Laboratory (INEEL) Site (Figure 1).

Nine wells have been identified as groundwater monitoring locations for WAG 5 sampling. Eight of these wells were sampled in October 2002 for the FY 2003 sampling event. Groundwater samples were not collected from well PBF-MON-A-003 because the pump failed to produce water at the surface. Based on sample results from the 2001 and 2002 sampling events, none of the analytes collected from PBF-MON-A-003 exceeded MCL. It is reasonable to assume that the 2003 data would be similar. The pump at PBF-MON-A-003 has subsequently been replaced, is operational, and ready for the FY 2004 sampling event.

1.1 Purpose

In accordance with the Groundwater Monitoring Plan (DOE-ID 2000a), this document has been written to present groundwater monitoring data collected during FY 2003 as well as historical data for the wells covered under the Groundwater Monitoring Plan. The data presented herein supplement the groundwater monitoring data previously presented in the *Waste Area Group 5 Operable Unit 5-12 Comprehensive Remedial Investigation/Feasibility Study* (RI/FS) (DOE-ID 1999) and are a compilation of the data for the potential contaminants in the WAG 5 groundwater. The purpose of this document is to present and summarize data regarding contaminant concentrations in the groundwater. Conclusions regarding trends and discussion of the trends have been developed in Section 4.1 of this document.

1.2 Groundwater Monitoring Requirements

As outlined in the groundwater monitoring plan, samples are to be collected from nine aquifer wells in the WAG 5 area. Samples are analyzed for radionuclides, organic, and inorganic constituents identified in Section 2 of this report. Each of the wells will be sampled on an annual basis until the first

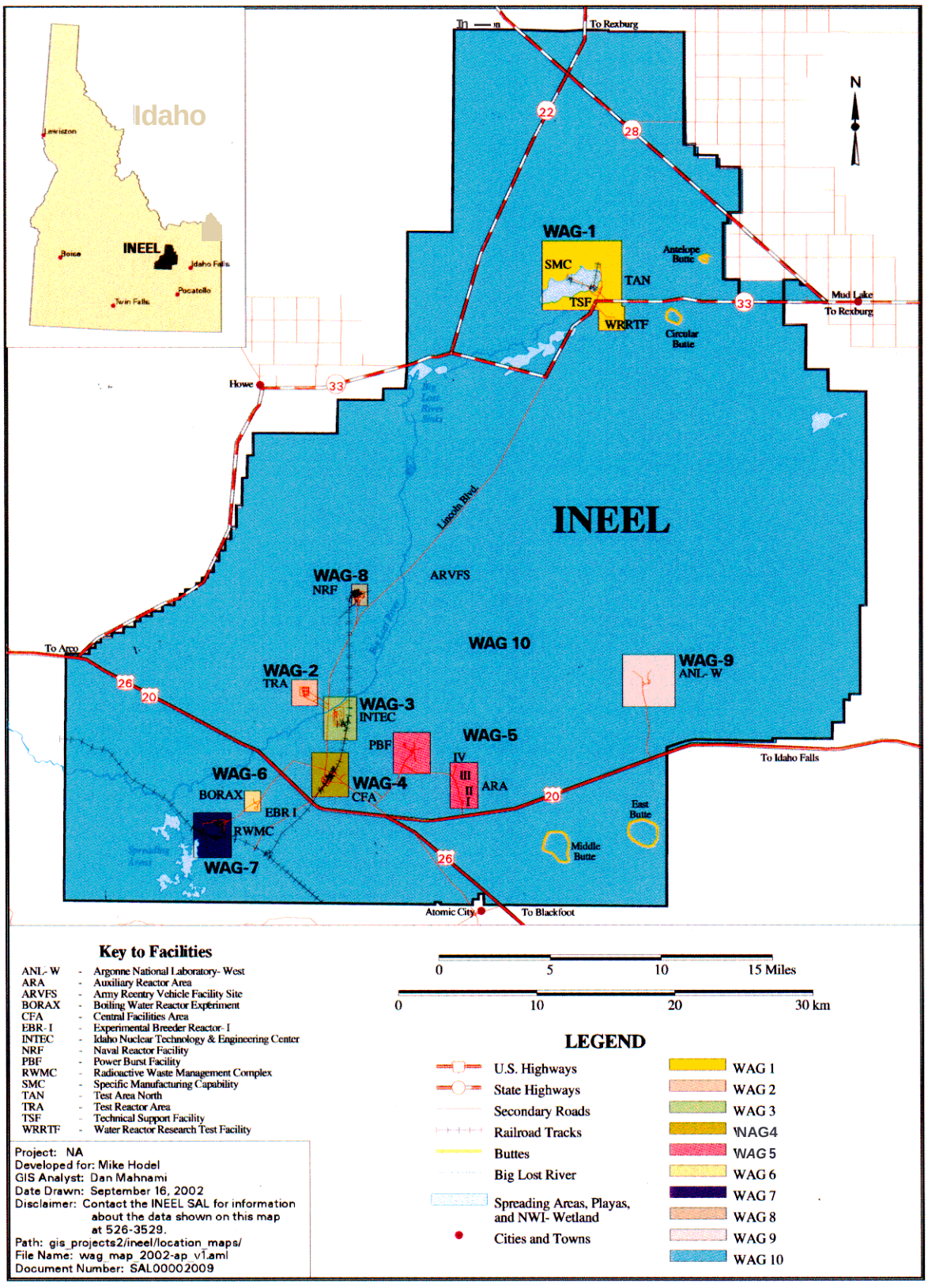

Figure 1. INEEL Site map showing WAG locations.

five-year review for Operable Unit 5-12, due to be completed in FY 2005. In addition, water level measurements are collected from 22 wells in the WAG 5 area. Table 1 provides a summary of the construction details from each of the WAG 5 groundwater monitoring and water level measurement wells.

Table 1. Summary of well information for WAG 5 groundwater monitoring wells.

Well Name	Total Depth (ft)	Monitoring Point Elevation (ft)	Screened Interval(s) Below Land Surface (ft)	Well Use
ARA-MON-A-001	650	5037.00	620–640	Sample
ARA-MON-A-002	629	5039.90	600–620	Sample
ARA-MON-A-03A	655	5052.70	624–644	Sample
ARA-MON-A-004	665	6057.00	625–645	Sample
PBF-MON-A-001	495	4908.17	454–484	Sample
PBF-MON-A-003	605	4961.13	545–575	Sample
PBF-MON-A-004	545	4942.42	522–542	Sample
PBF-MON-A-005	545	4977.98	516–536	Sample
SPERT-I	653	N/A	482–492 522–542 552–582 597–617 632–652	Sample
STF-MON-A-01A	998	4943.20	538–558	Water level
STF-MON-A-01A	999	4939.76	510–530	Water level
STF-MON-A-003	1005	4943.55	493–533	Water level
STF-MON-A-004	1007	4938.65	500–540	Water level
USGS-001	450	5042.06	600–630	Water level
USGS-005	454	4939.17	475–497	Water level
USGS-020	462	4719.07	467–477 515–552	Water level
USGS-082	531	4908.60	470–570 593–693	Water level
USGS-107	556	4919.45	270–690	Water level
USGS-110	559	5002.06	580–780	Water level
USGS-116	565	4918.60	401–438 438–572	Water level
NPR TEST	239	4935.09	504–532	Water level
NTP AREA 2	245	5130.13	667–722 742–814 844–876	Water level

2. MONITORING RESULTS

During FY 2003, organic, inorganic, and radionuclide samples were collected and analyzed, as discussed in the following sections. The analyses were performed in accordance with established INEEL and EPA methods, with the exception of radionuclide analyses. The radionuclide analyses were performed in accordance with the requirements delineated in the *Idaho National Engineering and Environmental Laboratory Sample and Analysis Management Statement of Work for Analytical Services* (INEEL 2002b). This statement of work establishes the minimum required detection limits and quality assurance requirements for the analytical methods to be employed. All analytical results were validated to resident procedures established by the INEEL Sample and Analysis Management (SAM) Office.

2.1 Organic Analyses

The volatile organic compound (VOC) analyses were performed in accordance with SW-846 Method 8260B (EPA 1986). With the exception of samples from wells ARA-MON-A-004, and PBF-MON-A-004 sample results for volatile organic compounds were below the maximum contaminant levels (MCLs) for all analytes. However, tetrachloroethene was detected in groundwater samples from wells ARA-MON-A-004, and PBF-MON-A-004 at concentrations of 5.1 μg/L, and 5.4 μg/L respectively. These concentrations exceed the EPA-defined maximum contaminant level for tetrachloroethene of 5 μg/L. These are the first samples from WAG 5 that contained tetrachloroethene at concentrations above the 5 μg/L MCL. The only other sample in which tetrachloroethene was detected, is from well PBF-MON-A-001 with a concentration of 1 μg/L in November 2000. Although sporadic detections for VOCs have been encountered from WAG 5 groundwater samples, VOCs (including tetrachloroethene) are not a regulatory concern. Tetrachloroethene concentrations from this sampling event above the MCL are considered to be anomalous, but will be verified by samples collected during future sampling events. Individual well summaries are included in Appendix A, and the data set for the complete list of VOCs is included in Appendix D.

2.2 Inorganic Analyses

Inorganic analyses included metals and anions. Metals analyses were performed in accordance with procedures delineated in SW-846 (EPA 1986). Specifically, mercury by SW-846 Method 7470A, silver by SW-846 Method 7760A, and the balance by SW-846 Method 3010A and SW-846 Method 6010B. Specific metals requested included arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Anion analysis included fluoride, chloride, bromide, nitrate, nitrite, orthophosphate, and sulfate. Anion sample analyses were performed in accordance with SW-846 Method 9056. All analytical results for metals and anions were below concentrations of regulatory concern. Lead which had been detected in previous sampling events at concentrations slightly above the EPA action level of 15 μg/L was below the action level in all samples collected. Lead concentrations decreased from the concentrations detected in the November 2001 sampling event as follows:

- Well ARA-MON-A-03A: reduced from 15.6 μg/L to 5.9 μg/L
- Well ARA-MON-A-004: reduced from 17.0 μg/L to 2.5 μg/L
- Well PBF-MON-A-004 reduced from 17.1 μg/L to 13.9 μg/L.

Excluding the production well SPERT I, each of the WAG 5 groundwater monitoring wells were installed with galvanized discharge and water access pipes. As part of the INEEL routine well maintenance program, pumps were removed and maintained, and galvanized pipes were removed and

replaced with stainless steel pipes in wells ARA-MON-A-001, and PBF-MON-A-004 during June 2003 Galvanized pipe removed from these wells showed evidence of corrosion and rusting.

Corrosion of galvanized pipes has been attributed to the presence of lead and zinc in groundwater samples from other wells located at the INEEL, specifically, wells in the CFA and Test Area North (TAN) areas. Following replacement of galvanized pipe with stainless steel pipe in other INEEL wells, the concentrations of lead and zinc decreased. In addition, galvanized piping in wells PBF-MON-A-001 and PBF-MON-A-005 was replaced with stainless steel pipe in August 2000, resulting in decreased lead concentrations in these wells. Consequently, the elevated lead concentrations in the ARA/PBF wells were probably the result of corroded galvanized pipe in the wells. With the replacement of galvanized pipe with stainless steel pipe, the lead concentrations appear to be decreasing. Subsequent rounds of groundwater sampling will be performed to verify that concentrations remain below concentrations of regulatory concern.

2.3 Radionuclide Analyses

Radionuclide analyses included gross alpha and beta, gamma spectrometry, tritium, and iodine-129. The analyses were performed in accordance with the requirements delineated in the INEEL radionuclide analytical statement of work (INEEL 2002b). For the FY 2003 sampling effort, the laboratory was requested to perform alpha and beta isotopic analyses only if the corresponding gross alpha or gross beta sample result exceeded 5 pCi/L. Because this did not occur for any of the well samples analyzed, it was not necessary to perform the isotopic tests. Neither tritium nor iodine-129 was detected in any of the samples. None of the analytes exceeded the EPA-defined MCLs for drinking water.

Although cesium-134 has not previously been detected in any of the groundwater samples collected for WAG 5, it was detected during the FY 2003 sampling event from well PBF-MON-A-005 at a concentration of 1.95 ± 0.58 pCi/L. This result is below the minimum detectable activity of 3.72 pCi/L for this analysis, and was flagged with a "J" by the validator, indicating that the result may be inaccurate or imprecise. Cesium-134 is a decay product of cesium-137, consequently, Cs-137 is generally expected to be present when Cs-134 is detected, especially given the fact that Cs-134 has a 2.06 year half-life, as compared to a 30.17 year half-life of Cs-137. However, Cs-137 was not detected in any of the samples. In addition, reactor operations that could potentially have contributed to the presence of either isotope, ceased at PBF in February 1985. Furthermore, well PBF-MON-A-005 is located upgradient of the PBF facility, and neither isotope has been detected in any of the downgradient wells. Although statistical analysis by the laboratory determined Cs-134 to be statistically present, the result is questionable, and continued monitoring during the next annual sampling event, which is scheduled for fall of 2003.

3. GROUNDWATER QUALITY AND TRENDS

3.1 Overall Quality

The greatest measure of overall quality of the groundwater underlying WAG 5 is made by using a comparison of the analytical data to the MCLs as defined by the EPA. Table 2 summarizes the minimum, maximum, and average results from the FY 2003 sampling round. This table also shows the background concentrations at the INEEL for the identified analytes. Results are presented only for those analytes that had at least one true-positive detection. However, nondetections were calculated into the average by using a value of one half of the detection limit for the sample concentration. Only gross alpha, arsenic, chromium, lead, and chloride were detected at concentrations above background concentrations. However, none were detected at concentrations above MCLs or EPA action level.

Table 2. WAG 5 groundwater quality summary for FY-2003.

Analyte	Background[a]	Maximum	Minimum	Average Including Non-detects[b]	Number of Wells with Detections above MCL	Number of Samples	MCL
Gross beta (pCi/L)	0 to 7	4.77	2.28	3.17	0	9	4 mrem/yr (approx 50 pCi/L)
Gross alpha (pCi/L)	0 to 3	3.92	**ND** (-0.158)	2.08	0	9	15
Arsenic (µg/L)	2 to 3	4.9	2.20	3.24	0	9	50
Barium (µg/L)	50 to 70	51.3	30.90	40.37	0	9	2000
Cadmium (µg/L)	< 1	0.37	**ND** (<0.3)	0.17[c]	0	9	5
Chromium (µg/L)	2 to 3	9.8	**ND** (<3.9)	2.91[c]	0	9	100
Lead (µg/L)	1 to 5	13.9	**ND** (<2.5)	3.84[c]	0	9	15[d]
Fluoride (mg/L)	0.4 to 0.5	0.4	0.19	0.31	0	9	4[e]
Chloride (mg/L)	16 to 27	29.3	13.90	19.23	0	9	250[f]
Nitrate (mg/L)	1 to 2	1.1	0.27	0.94	0	9	10
Tetrachloroethene (µg/L)	Not Available[g]	5.4	**ND** (<5.0)	2.64	2	9	5
Sulfate (mg/L)	24 to 31	23.5	17.00	20.04	0	9	250[f]

a. Background concentrations are from Knobel, Orr, and Cecil (1992)
b. Non detects were calculated into the average using a value of 1/2 of the detection limit.
c. Average is less than the minimum as a result of using 1/2 of the detection limit for non detections in the average calculation.
d. Concentration represents the EPA-defined action level for this contaminant.
e. For fluoride, there exists a 2mg/L secondary standard in addition to the MCL.
f. Concentration represents the EPA-defined secondary standard for this contaminant.
g. Background concentrations for tetrachloroethene are not available but it is considered to be not present

3.2 Trend Analysis

Lead concentrations versus time were plotted for each of the nine WAG 5 monitoring wells, and are included in Appendix B. Because lead has been a concern in the past with concentrations above the MCL, and two samples from the 2003 sampling event are near the MCL, it is the only analyte for which graphs were prepared. Statistical trend analysis was performed on the lead concentration from wells ARA-MON-A-001, ARA-MON-A-002, ARA-MON-A-03A, ARA-MON-A-004, PBF-MON-A-001, and PBF-MON-A-004 because only these wells had enough positive detectable lead concentrations upon which the statistical tests could be performed.

For the WAG 5 groundwater monitoring, a 0.05 significance level (95% confidence) was used to determine whether a trend in the data exists. Calculated statistical parameters included the correlation coefficient (r), the r^2 value, the p-value, and the slope.

Lead data were evaluated against the calculated regression coefficients to determine whether a significant statistical trend exists. The correlation coefficient and the r^2 value indicate how well the regression line fits the data. In general, a correlation coefficient close to one or negative one, and r^2 values close to one indicate a good fit of the regression line to the data. The direction of the trend may be ascertained based on whether the correlation coefficient is positive or negative. At the 95% confidence level, a p-value of less than 0.05 indicates that a statistically significant trend exists.

Based upon the calculated regression coefficients from the limited data available, there does not appear to be a statistically significant trend in the lead data from any of the WAG 5 wells. However, additional sampling rounds will provide greater insight as to whether or not a trend truly does exist.

Table 3 provides a summary of the calculated regression coefficients (at the 95% confidence level) for the lead data. For samples in which lead was not detected, a value of one half the detection limit was used to calculate the regression coefficients. It should be noted that these data sets are limited, and any statistical inferences based upon the data may be premature.

Table 3. Statistical trend analysis.

Well	Slope	Correlation Coefficient	p-value	Significant Statistical Trend	r^2
ARA-MON-A-001	-0.0023	0.351	0.440	No	0.123
ARA-MON-A-002	-0.0026	0.712	0.072	No	0.508
ARA-MON-A-03A	-0.0025	0.441	0.322	No	0.194
ARA-MON-A-004	-0.0022	0.308	0.551	No	0.095
PBF-MON-A-001	-0.0027	0.770	0.099	No	0.449
PBF-MON-A-004	0.0042	0.722	0.168	No	0.521

3.3 Groundwater Level Measurements

In October 2002, water level measurements were obtained from the 21 monitoring wells in the WAG 5 area, prior to the time that they were sampled. This data is presented in Table 4, and was used to prepare the contour map of the water table illustrated in Figure 2. Similar to past groundwater contour maps of the WAG 5 area, the contour map of the October 2002 data shows steep contours in the PBF area with the direction of hydraulic gradient somewhat counter to the regional S-SW gradient. Using three-well combinations, hydraulic gradient calculations were prepared and recorded in Table 5. An additional contour map (Figure 3) was prepared and with the individual gradient calculations displayed as directional frequency "rose diagrams" overlaid on the map.

Elevation surveys conducted by the INEEL civil surveyor, and borehole deviation logs using the USGS-owned gyroscopic tool, were collected from several of these wells. Table 6 compares the recent survey and logging results for the PBF monitoring wells with the previous information for these wells. This new data suggests that only slight differences in the values for land surface and measuring point elevations (0.13 ft or less), and for the borehole deviation data (0.08 ft or less) are apparent.

4. CONCLUSIONS AND RECOMMENDATIONS

The following sections summarize the conclusions and recommendations based on the groundwater monitoring events that have occurred to date.

4.1 Conclusions

Groundwater monitoring for FY 2003 was completed during October 2002 in accordance with the requirements delineated in the WAG 5 ROD (DOE-ID 2000b) and the Groundwater Monitoring Plan (DOE-ID 2000a). As discussed in Appendix C, all data quality objectives defined in the Groundwater Monitoring Plan (DOE-ID 2000a) were met except for completeness. The Groundwater Monitoring Plan requires that 90% of planned samples be collected. However, because pump problems prevented sample collection from well PBF-MON-A-003, sample completeness for the Fiscal Year 2003 sampling event was 89%. The pump at PBF-MON-A-003 has been replaced and is operational again.

Table 4. Summary of around water data from October 2002

Well Name	Land Surface Datum (ft above MSL)	Completion Depth (ft blsd)	Completion Depth below Water Table (ft)	Water Level Date	Water Level (ft blsd)	Water Table Elevation (ft above MSL)	Borehole Deviation Correction Factor (ft)
ARA-MON-A-001	5034.30	596	4	101912002	592.39	4442.4	0.47
ARA-MON-A-002	5037.40	620	24	101912002	595.64	4441.9	0.1
ARA-MON-A-004	5064.60	645	24	101912002	620.64	4444.0	0.08
ARA-MON-A-03A	5050.10	644	38	101912002	606.21	4444.0	0.12
NPR TEST	4933.15	600	134	10/1012002	465.77	4467.4	No info
NTP AREA 2	5128.42	877	203	10/1712002	674.33	4454.1	No info
PBF-MON-A-001	4906.15	489	44	10/1712002	445.45	4460.7	0.02
PBF-MON-A-003	4959.29	575	53	101912002	521.58	4439.6	0.06
PBF-MON-A-004	4939.66	542	43	10/1712002	499.04	4443.5	0.06
PBF-MON-A-005	4976.13	531	19	10/1712002	512.41	4463.8	0.08
STF-MON-A-003	4937.01	565	64	10/1712002	501.16	4436.0	0.14
STF-MON-A-004	4945.37	573	64	10/1712002	509.05	4436.4	0.1
STF-MON-A-01A	4941.40	558	54	10/1712002	503.82	4437.6	0.03
STF-MON-A-02A	4937.30	530	32	10/1712002	498.25	4439.1	0.02
USGS-001	5022.71	636	45	10/1712002	590.87	4432.0	0.19
USGS-005	4937.79	500	29	10/1012002	470.94	4466.8	No info
USGS-020	4916.36	676	210	101112002	465.90	4450.5	0.07
USGS-082	4906.83	700	249	101312002	451.04	4455.8	0.03
USGS-107	4917.50	690	207	10/1712002	483.06	4434.4	No info
USGS-110	4999.97	780	212	10/1712002	568.16	4431.9	0.06
USGS-116	4916.03	580	117	10/1/2002	462.59	4453.6	0.20

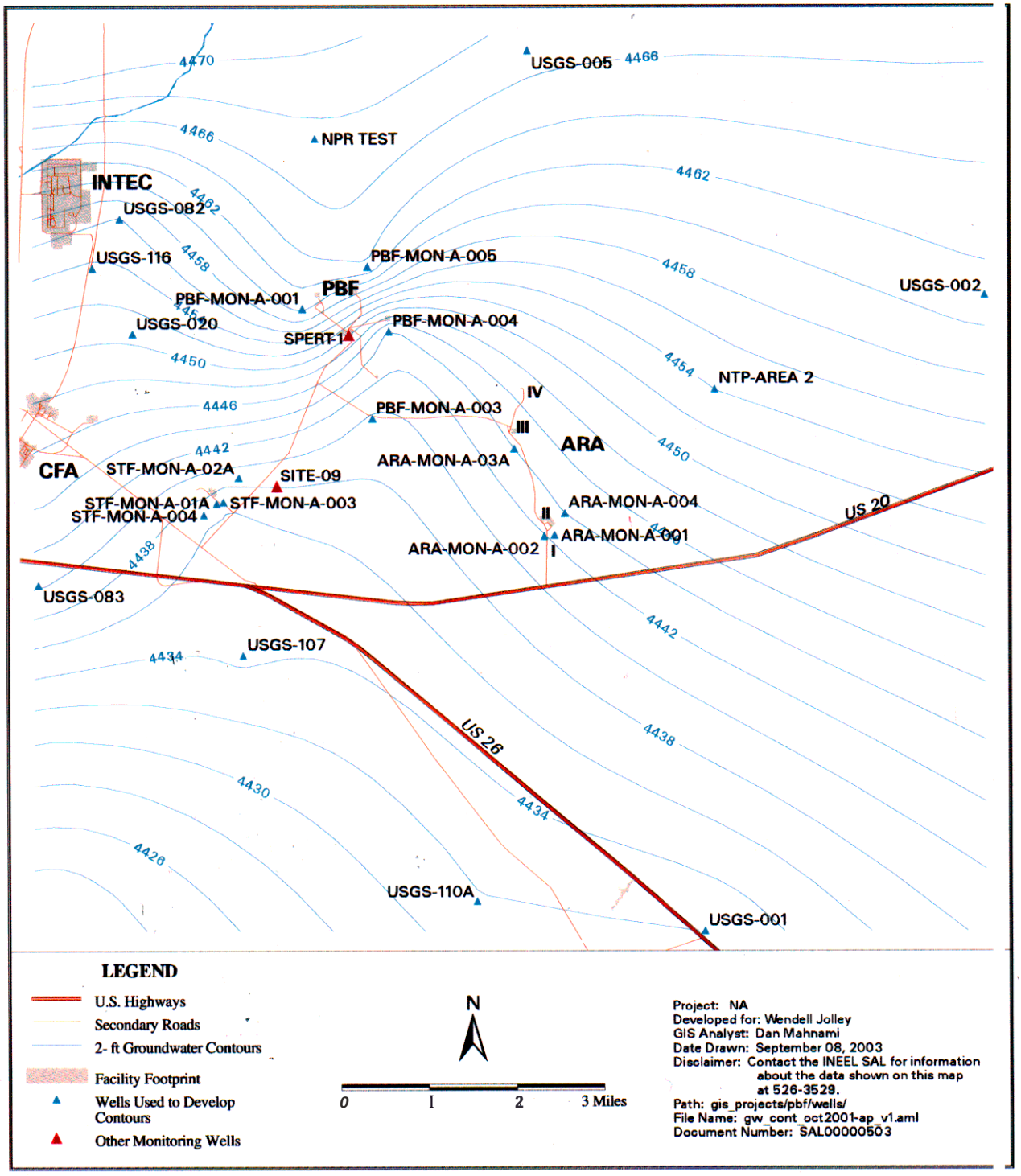

Figure 2. WAG 5 groundwater contour map of October 2002 data.

Table 5. Summary of hydraulic gradient calculations.

Component Wells			Size (mi^2)	Number of Calculations	Gradient Direction (degrees N)				Gradient Magnitude (ft/mi)			
					Min	Max	Mean	Standard Deviation	Min	Max	Mean	Standard Deviation
Combinations with adequate number of calculations (>20)												
NPR-TEST	USGS-020	USGS-082	1.52	61	212	243	227	7	5	6	5	0.3
NTP-AREA 2	USGS-005	USGS-082	11.0	49	194	205	197	2	3	24	6	4.9
NTP-AREA 2	USGS-020	USGS-082	4.31	37	193	203	198	3	2	5	3	0.6
NTP-AREA 2	USGS-082	USGS-083	15.1	27	193	201	197	2	3	4	4	0.3
USGS-001	USGS-002	USGS-005	23.4	90	136	203	197	11	4	11	4	1.9
USGS-001	USGS-005	USGS-083	34.2	49	191	203	194	3	4	12	5	2.4
USGS-020	USGS-083	USGS-107	3.78	26	166	181	173	4	4	5	4	0.2
USGS-082	USGS-083	USGS-107	5.25	26	161	180	171	5	3	4	4	0.2
Combinations with inadequate number of calculations (<20)												
ARA-MON-A-001	ARA-MON-A-004	ARA-COR-A-005	0.02	6	180	222	210	15	5	8	6	1.1
ARA-MON-A-002	PBF-MON-A-005	STF-MON-A-02A	4.68	13	190	200	198	3	8	10	9	0.4
ARA-MON-A-002	USGS-005	USGS-116	14.0	7	185	188	186	1	5	5	5	0.1
ARA-MON-A-03A	NPR-TEST	STF-MON-A-02A	5.92	5	187	192	191	2	7	7	7	0.1
ARA-MON-A-03A	PBF-MON-A-005	STF-MON-A-02A	3.53	12	177	188	185	3	9	11	10	0.4
NPR TEST	NTP-AREA 2	USGS-020	8.04	9	189	193	190	1	5	7	6	0.4
NPR-TEST	PBF-MON-A-001	PBF-MON-A-005	0.69	6	212	235	223	11	4	6	5	1.0
NTP-AREA 2	NPR-TEST	USGS-005	5.75	13	152	163	158	3	2	3	3	0.3
NTP-AREA 2	USGS-005	USGS-107	13.7	8	201	206	204	2	4	4	4	0.1
NTP-AREA 2	USGS-020	USGS-107	11.8	14	192	197	193	2	5	5	5	0.2
NTP-AREA 2	USGS-082	USGS-107	15.6	10	195	199	198	1	4	5	5	0.2
NTP-AREA 2	USGS-082	USGS-110A	22.5	13	195	201	198	2	2	5	4	0.9
NTP-AREA 2	USGS-107	USGS-116	14.5	7	190	195	193	2	5	5	5	0.2
MORE	SPERT-1	USGS-020	2.26	12	206	226	215	6	5	9	7	1.0
USGS-002	USGS-005	USGS-107	22.5	12	196	203	200	2	4	5	4	0.2

Table 5. (continued).

Component Wells			Size (mi^2)	Number of Calculations	Gradient Direction (degrees N) Min	Max	Mean	Standard Deviation	Gradient Magnitude (ft/mi) Min	Max	Mean	Standard Deviation
Combinations that include either PBF-MON-A-003 or PBF-MON-A-004												
ARA-MON-A-001	ARA-MON-A-003	PBF-MON-A-003	0.72	38	210	249	245	8	1	5	2	0.7
ARA-MON-A-001	NTP-AREA 2	PBF-MON-A-003	2.94	17	223	229	226	2	4	5	5	0.3
ARA-MON-A-002	NTP-AREA2	PBF-MON-A-004	3.76	12	226	235	230	4	4	5	5	0.2
PBF-MON-A-001	PBF-MON-A-003	PBF-MON-A-004	0.52	16	103	167	112	15	12	18	16	1.3
PBF-MON-A-001	PBF-MON-A-003	PBF-MON-A-005	0.66	14	161	176	168	6	13	15	14	0.6
PBF-MON-A-001	PBF-MON-A-004	PBF-MON-A-005	0.33	14	155	172	159	4	15	31	27	3.7
PBF-MON-A-003	PBF-MON-A-004	PBF-MON-A-005	0.19	14	102	258	118	42	15	77	51	13

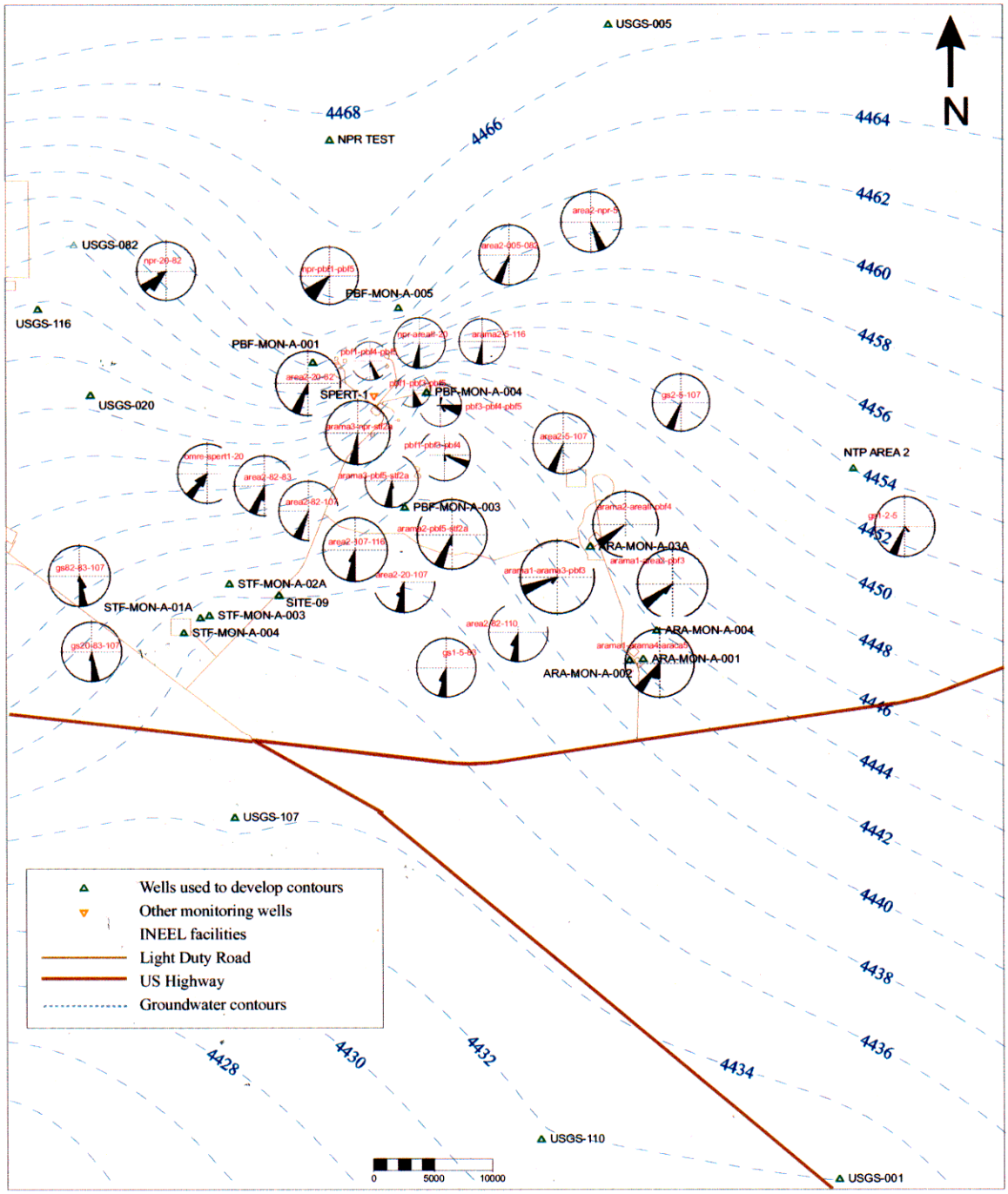

Figure 3. WAG 5 groundwater contour map of October 2002 data, **including frequency distribution plots.**

Table 6. Summary of civil survey and borehole deviation logging results.

	Differences in Previous and Recent Datum Surveys					Borehole Deviation Results	
Well	Easting Difference	Northing Difference	Previous Land Surface Elevation	Recently Surveyed Land Surface Elevation	Land Surface Difference	Borehole Deviation Correction	Deviation Logging Tool
PBF-MON-A-001	0.04	0.08	4906.15	4906.06	0.09	0.02	Magnetic
PBF-MON-A-003	0.04	0.06	4959.29	4959.26	0.03	0.06	Digital gyro
PBF-MON-A-004	0.06	0.09	4939.66	4939.53	0.13	0.06	Digital gyro
PBF-MON-A-005	0.01	0.11	4976.13	4976.06	0.07	0.08	Magnetic

With the exception of tetrachloroethene, all constituents analyzed from the groundwater samples collected during the October 2002 sampling event were below MCLs. Tetrachloroethene exceeded the EPA action level of 5 μg/L in wells ARA-MON-A-004 (5.1 μg/L) and PBF-MON-A-004 (5.4 μg/L). This is the first time that this constituent has been detected in the groundwater in the ARA/PBF area. Tetrachloroethene concentrations will be evaluated during the next groundwater sampling event.

Lead concentrations, which have been above MCLs in several wells in the past were all below MCLs from the October 2002 data. Replacement of galvanized pipe with stainless steel pipe appears to have removed the source of the lead, consequently lead concentrations should continue to decline to background concentrations.

Although cesium-134 was considered to be statistically present in the sample from well PBF-MON-A-005 at a concentration of 1.95 ± 0.58 pCi/L, the result is considered to be inaccurate for the reasons stated in Section 2.3. Cesium concentrations will be evaluated during the next groundwater sampling event. Overall, the analyte concentrations appear to remain consistent with the results obtained historically.

Groundwater contour maps were prepared from the water elevations measured during October 2002 and continue to show a steep hydraulic gradient in the PBF area consistent with previous contour maps from the area. Neither elevation surveys of the survey marker and measuring point, nor borehole deviation logging of the PBF wells provided information that would suggest that the steep hydraulic gradient is the result of measurement error, or borehole deviation effects. Future well maintenance will include collection of gyroscopic borehole deviation logs from wells that to do not currently have gyroscopic borehole deviation logs, which may provide further insight to the steep hydraulic gradient in the PBF area.

4.2 Recommendations

Groundwater monitoring is recommended to continue at the nine wells utilized by WAG 5 at the frequency prescribed in the Groundwater Monitoring Plan (DOE-ID 2000a).

For overall comparability of the groundwater analytical data, it is recommended that groundwater samples for WAG 5 continue to be collected at approximately the same time of year for each annual event. WAG 5 is currently scheduled for annual sampling during November of each year.

5. REFERENCES

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INEEL, 2002b, *Idaho National Engineering and Environmental Laboratory Sample and Analysis Management Statement of Work for Analytical Services,* ER-SOW-394, Rev 1, December 2002.

Knobel, L. L., B. R. Orr, and L. D. Cecil, 1992, "Summary of Background Concentrations of Selected Radiochemical and Chemical Constituents in Groundwater from the Snake River Plain Aquifer Idaho: Estimated from an Analysis of Previously Published Data," *Journal of Idaho Academy of Science,* Vol. 28, No. 1, 1992.

Appendix A

Individual Well Summary Tables

Appendix A
Individual Well Summary Tables

ARA-MON-A-001

Historical Data Range 1995–2001		Sample Number: 5GW01501 Date Sampled: 10/30/02		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
4.3	**ND**	Gross Alpha	3.22 ± 0.762	J
4.62	**ND**	Gross Beta	4.38 ± 0.527	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	1.89E-01 ± 0.839	U
ND	**ND**	Cs-137	-2.08E-01 ± 0.987	U
ND	**ND**	Tritium (pCi/L)	-1.63E+02 ± 1.03E+02	U
ND	**ND**	Iodine-129 (pCi/L)	6.42E-02 ± 3.43E-02	U
		Metals (µg/L)		
141	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
2.9	**ND**	Arsenic	4.3	B J
37.7	31.7	Barium	39.3	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.3	U
3.9	**ND**	Chromium	3.9	U
ND	**ND**	Copper	NS	
95.5	**ND**	Iron	NS	
13.8	5.7	Lead	11.9	E
ND	**ND**	Manganese	NS	
ND	**ND**	Mercury	0.10	U
ND	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
634	438	Zinc	NS	
		Anions (mg/L)		
20.8	17.8	Chloride	17.3	E
0.511	0.4	Fluoride	0.39	B
6	1.14	Nitrate	1.1	
0.2	**ND**	Nitrite	0.1	U
1.2	1.1	Nitrate/Nitrite	NS	
20.2	17	Sulfate	18.7	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
23	23	Tetrachloroethene	1.2	J

ND = Non-detection.
NS = Not sampled.
B = Result is less than the contract required reporting limit, but greater than or equal to the instrument detection limit.
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J = Analyte was detected, but the associated value is an estimate and may be inaccurate.
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UJ = The analyte was analyzed for but not detected. The associated value is an estimate, and may be inaccurate.

ARA-MON-A-002

Historical Data Range 1995–2001		Sample Number: 5GW01601 Date Sampled: 10/29/02		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.42	**ND**	Gross Alpha	2.44 ± 0.797	J
3.86	**ND**	Gross Beta	2.92 ± 0.558	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	1.24E+00 ± 0.911	U
ND	**ND**	Cs-137	-3.47E-01 ± 0.862	U
ND	**ND**	Tritium (pCi/L)	-2.2E+02 ± 1.03E+02	U
ND	**ND**	Iodine-129 (pCi/L)	3.51E-02 ± 1.09E-01	U
		Metals (µg/L)		
ND	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
ND	**ND**	Arsenic	4.9	B J
43.7	31.5	Barium	39.1	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.37	B J
6.1	3.2	Chromium	4.4	U
ND	**ND**	Copper	NS	
61.2	**ND**	Iron	NS	
13	6.2	Lead	2.5	U
ND	**ND**	Manganese	NS	
0.03	**ND**	Mercury	0.10	U
2.6	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
694	438	Zinc	NS	
		Anions (mg/L)		
20	18.2	Chloride	17.6	E
0.521	0.4	Fluoride	0.4	B
5.9	1.14	Nitrate	1.1	
0.2	**ND**	Nitrite	0.1	U
1.2	1.2	Nitrate/Nitrite	NS	
21.2	18.1	Sulfate	18.9	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
ND	**ND**	Tetrachloroethene	5	U

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ARA-MON-A-03A

Historical Data Range 1995–2001 Maximum	Minimum		Sample Number: 5GW01701 Date Sampled: 10/29/02 Analysis	Flag
		Gross Alpha/Beta (pCi/L)		
ND	**ND**	Gross Alpha	3.92 ± 0.909	J
4.5	**ND**	Gross Beta	4.77 ± 0.584	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	4.15E-2 ± 1.29	U
ND	**ND**	Cs-137	0.00 ± 1.53	U
ND	**ND**	Tritium (pCi/L)	4.48E+01 ± 1.09E+02	U
ND	**ND**	Iodine-129 (pCi/L)	5.93E-02 ± 1.71E-01	U
		Metals (µg/L)		
ND	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
2.6	**ND**	Arsenic	2.9	BJ
40.6	36.3	Barium	45.2	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.3	U
4.3	**ND**	Chromium	5.9	U
ND	**ND**	Copper	NS	
109	**ND**	Iron	NS	
22.2	11	Lead	2.5	U
2.8	1.6	Manganese	NS	
0.03	**ND**	Mercury	0.10	U
2.3	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
1110	503	Zinc	NS	
		Anions (mg/L)		
23.9	20.6	Chloride	20.4	E
0.481	0.4	Fluoride	0.4	B
5.8	1.29	Nitrate	1.3	
0.2	**ND**	Nitrite	0.1	U
1.4	1.3	Nitrate/Nitrite	NS	
22	21	Sulfate	20.8	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
ND	**ND**	Tetrachloroethene	5	U

ND = Non-detection.
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ARA-MON-A-004

Historical Data Range		Sample Number: 5GW01801			Sample Number: 5GW01802(DUP)	
1995–2001		Date Sampled: 10/30/02			Date Sampled: 10/30/03	
Maximum	Minimum	Analysis		Flag	Analysis	Flag
		Gross Alpha/Beta (pCi/L)				
2.18	**ND**	Gross Alpha	2.1E+00 ± 0.749	UJ	2.36E+00 ± 0.976	UJ
3.28	**ND**	Gross Beta	2.41E+00 ± 0.544	J	2.96E+00 ± 0.624	J
		Gamma Spec. (pCi/L)				
ND	**ND**	Co-60	2.53E+00 ± 1.92	U	7.87E-01 ± 1.00	U
ND	**ND**	Cs-137	-1.32E-01 ± 0.902	U	-1.72E-00 ± 0.973	U
ND	**ND**	Tritium (pCi/L)	-4.72E+01 ± 9.28E+01	U	-7.02E+01 ± 1.04E+02	U
ND	**ND**	Iodine-129 (pCi/L)	1.63E-01 ± 0.104	U	-4.28E+02 ± 0.112	U
		Metals (µg/L)				
ND	**ND**	Aluminum	NS		NS	
ND	**ND**	Antimony	NS		NS	
3.4	**ND**	Arsenic	2.8	B J	2.9	B J
38.3	32.7	Barium	40.4	B	39.8	B
ND	**ND**	Beryllium	NS		NS	
0.3	**ND**	Cadmium	0.3	U	0.3	U
37	**ND**	Chromium	4.4	U	4.2	U
4.4	**ND**	Copper	NS		NS	
16600	**ND**	Iron	NS		NS	
49.2	5.9	Lead	2.5	U	2.5	U
33.5	1.7	Manganese	NS		NS	
0.03	**ND**	Mercury	0.1	U	0.1	U
2.8	**ND**	Selenium	3.3	U	3.3	U
ND	**ND**	Silver	1.4	U	1.4	U
ND	**ND**	Thallium	NS		NS	
4030	643	Zinc	NS		NS	
		Anions (mg/L)				
21.5	17.7	Chloride	17.8	E	17.8	E
0.542	0.3	Fluoride	0.39	B	0.39	B
5.2	1.08	Nitrate	1.1	J	1.1	
0.2	**ND**	Nitrite	0.1	U	0.1	U
1.2	1.2	Nitrate/Nitrite	NS		NS	
20.8	19	Sulfate	18.8	E	18.9	E
		Organics (µg/L)				
ND	**ND**	Chloroform	5	U	5	U
ND	**ND**	Trichloroethene	5	U	5	U
ND	**ND**	Tetrachloroethene	1.3	J	5.1	

ND = Non-detection
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PBF-MON-A-001

Historical Data Range 1995–2001		Sample Number: 5GW01901 Date Sampled: 10/29/02		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
3.3	**ND**	Gross Alpha	3.86E+00 ± 7.37E-01	J
3.8	**ND**	Gross Beta	2.54E+00 ± 5.34E-01	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	1.07E+00 ± 9.95E-01	U
ND	**ND**	Cs-137	-1.48E+00 ± 1.03E+00	U
879	**ND**	Tritium (pCi/L)	-1.16E+02 ± 1.01E+02	U
ND	**ND**	Iodine-129 (pCi/L)	1.44E-01 ± 4.55E-02	UJ
		Metals (µg/L)		
ND	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
ND	**ND**	Arsenic	3.1	B J
37.1	26.1	Barium	30.9	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.3	U
5.5	**ND**	Chromium	4.4	U
ND	**ND**	Copper	NS	
320	**ND**	Iron	NS	
13.6	1	Lead	2.5	U
14.3	13.1	Manganese	NS	
0.03	**ND**	Mercury	0.10	U
ND	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
955	849	Zinc	NS	
		Anions (mg/L)		
17.7	15.9	Chloride	15.8	E
0.275	0.2	Fluoride	0.4	B
1.6	0.35	Nitrate	0.27	B
0.2	**ND**	Nitrite	0.1	U
0.34	0.28	Nitrate/Nitrite	NS	
18.9	17.4	Sulfate	17	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
ND	**ND**	Tetrachloroethene	5	U

ND = Non-detection.
NS = Not samuled.
B = Result is less than the contract required reporting limit, but greater than or equal to the instrument detection limit.
E = Post digestion spike is outside the control limits.
J = Analyte was detected, but the associated value is an estimate and may be inaccurate.
U = The analyte was not detected.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate, and may be inaccurate.

PBF-MON-A-003

Historical Data Range 1995–2001		Sample Number: Not Sampled Date Sampled: Not Sampled	
Maximum	Minimum	Analysis	Flag
		Gross Alpha/Beta (pCi/L)	
1.79	**ND**	Gross Alpha	NS
2.72	**ND**	Gross Beta	NS
		Gamma Spec. (pCi/L)	
ND	**ND**	Co-60	NS
ND	**ND**	Cs-137	NS
ND	**ND**	Tritium (pCi/L)	NS
ND	**ND**	Iodine-129 (pCi/L)	NS
		Metals (μg/L)	
ND	**ND**	Aluminum	NS
ND	**ND**	Antimony	NS
3	**ND**	Arsenic	NS
51.8	43.4	Barium	NS
ND	**ND**	Beryllium	NS
ND	**ND**	Cadmium	NS
16.5	5.2	Chromium	NS
ND	**ND**	Copper	NS
62	**ND**	Iron	NS
7.1	**ND**	Lead	NS
3.4	**ND**	Manganese	NS
0.03	**ND**	Mercury	NS
ND	**ND**	Selenium	NS
ND	**ND**	Silver	NS
ND	**ND**	Thallium	NS
38.9	8.8	Zinc	NS
		Anions (mg/L)	
15.1	13.6	Chloride	NS
0.319	0.2	Fluoride	NS
2.6	0.66	Nitrate	NS
0.1	**ND**	Nitrite	NS
0.67	0.64	Nitrate/Nitrite	NS
24	20.8	Sulfate	NS
		Organics (μg/L)	
ND	**ND**	Chloroform	NS
ND	**ND**	Trichloroethene	NS
ND	**ND**	Tetrachloroethene	NS

ND = Not detected
NS = Not samuled.

PBF-MON-A-004

Historical Data Range 1995–2001		Sample Number: 5GW02 101 Date Sampled: 10/30/02		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.19	**ND**	Gross Alpha	1.56E+00 ± 5.37E-01	UJ
1.58	**ND**	Gross Beta	2.28E+00 ± 4.34E-01	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	2.53E+00 ± 1.92E+00	U
ND	**ND**	Cs-137	-8.37E-01 ± 8.71E-01	U
5010	**ND**	Tritium (pCi/L)	-8.30+01 ± 1.05E+02	U
ND	**ND**	Iodine-129 (pCi/L)	1.61E-01 ± 9.70E-02	U
		Metals (µg/L)		
ND	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
ND	**ND**	Arsenic	3.8	B
26.9	25.1	Barium	32.7	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.3	U
7.1	**ND**	Chromium	9.8	B
ND	**ND**	Copper	NS	
ND	**ND**	Iron	NS	
17.5	5.6	Lead	13.9	E
ND	**ND**	Manganese	NS	
0.03	**ND**	Mercury	0.10	U
2.4	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
609	533	Zinc	NS	
		Anions (mg/L)		
22	13.35	Chloride	29.3	E
0.23	**ND**	Fluoride	0.19	B
2.2	0.51	Nitrate	0.85	B
N	**ND**	Nitrite	0.1	U
NS	NS	Nitrate/Nitrite	NS	
22.8	18.18	Sulfate	22.2	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
ND	**ND**	Tetrachloroethene	5	U

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PBF-MON-A-005

Historical Data Range 1995–2001		Sample Number: 5GW022021 Date Sampled: 10/29/02		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.35	**ND**	Gross Alpha	3.02E+00 ± 6.48E-01	J
2.12	**ND**	Gross Beta	3.69E+00 ± 5.34E-01	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	-3.10E-02 ± 9.61E-01	U
ND	**ND**	Cs-137	7.30E-01 ± 9.45E-01	U
ND	**ND**	Tritium (pCi/L)	1.73E+02 ± 1.11E+02	U
ND	**ND**	Iodine-129 (pCi/L)	2.22E-02 ± 1.05E-01	U
		Metals (µg/L)		
ND	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
ND	**ND**	Arsenic	2.3	B
53.6	48.2	Barium	44.6	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.3	U
6.6	6.3	Chromium	8.1	B
8.5	**ND**	Copper	NS	
60.7	**ND**	Iron	NS	
12.7	1.1	Lead	2.5	U
3.4	**ND**	Manganese	NS	
ND	**ND**	Mercury	0.10	U
2	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
998	909	Zinc	NS	
		Anions (mg/L)		
16	14.6	Chloride	13.9	E
0.25	0.19	Fluoride	0.9	B
3.2	0.69	Nitrate	0.66	B
ND	**ND**	Nitrite	0.1	U
NS	NS	Nitrate/Nitrite	NS	
22.2	21.08	Sulfate	21.6	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
ND	**ND**	Tetrachloroethene	5	U

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NS = Not sampled.
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U = The analyte was not detected.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate, and may be inaccurate.

SPERT-I

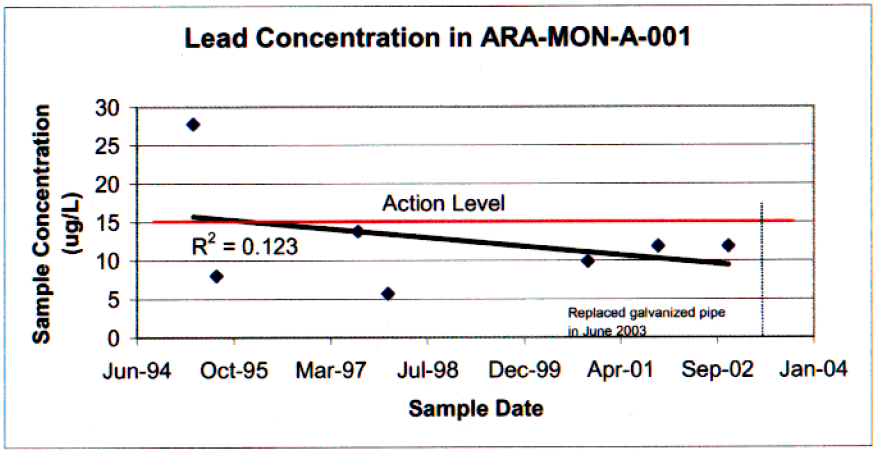
Historical Data Range 1995–2001		Sample Number: 5GW02301 Date Sampled: 10/29/02		
Maximum	Minimum	Analysis		Flag
		Gross Alpha/Beta (pCi/L)		
2.35	**ND**	Gross Alpha	-1.58E-01 ± 5.92E-01	UJ
3.33	**ND**	Gross Beta	2.58E+00 ± 4.59E-01	J
		Gamma Spec. (pCi/L)		
ND	**ND**	Co-60	2.49E+00 ± 1.18E+00	UJ
ND	**ND**	Cs-137	9.65E-01 ± 1.01E+00	U
ND	**ND**	Tritium (pCi/L)	-7.25E+01 ± 9.76E+01	U
ND	**ND**	Iodine-129 (pCi/L)	2.78E-01 ± 9.73E-02	U
		Metals (µg/L)		
ND	**ND**	Aluminum	NS	
ND	**ND**	Antimony	NS	
ND	**ND**	Arsenic	2.2	B
53.6	48.2	Barium	51.3	B
ND	**ND**	Beryllium	NS	
ND	**ND**	Cadmium	0.3	U
6.6	**ND**	Chromium	7.2	B
8.5	**ND**	Copper	NS	
60.7	**ND**	Iron	NS	
30	**ND**	Lead	2.5	U
3.4	**ND**	Manganese	NS	
0.03	**ND**	Mercury	0.10	U
2	**ND**	Selenium	3.3	U
ND	**ND**	Silver	1.4	U
ND	**ND**	Thallium	NS	
60	7.8	Zinc	NS	
		Anions (mg/L)		
26.2	22.1	Chloride	23.2	E
0.287	0.2	Fluoride	0.2	B
6.2	1.02	Nitrate	0.84	B
ND	**ND**	Nitrite	0.1	U
NS	NS	Nitrate/Nitrite	NS	
26.1	22.34	Sulfate	23.5	E
		Organics (µg/L)		
ND	**ND**	Chloroform	5	U
ND	**ND**	Trichloroethene	5	U
ND	**ND**	Tetrachloroethene	5	U

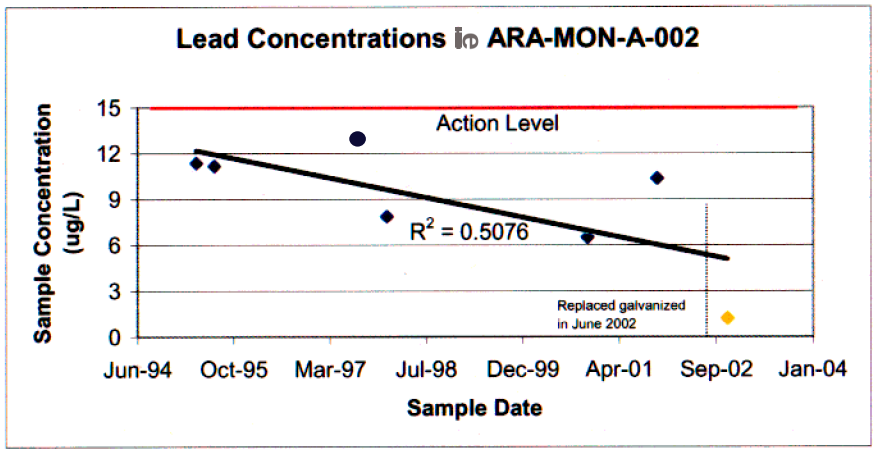
ND = Non-detection.
NS = Not sampled.
B = Result is less than the contract required reporting limit, but greater than or equal to the instrument detection limit.
E = Post digestion spike is outside the control limits.
J = Analyte was detected, but the associated value is an estimate and may be inaccurate.
U = The analyte was not detected.
UJ = The analyte was analyzed for but not detected. The associated value is an estimate, and may be inaccurate.

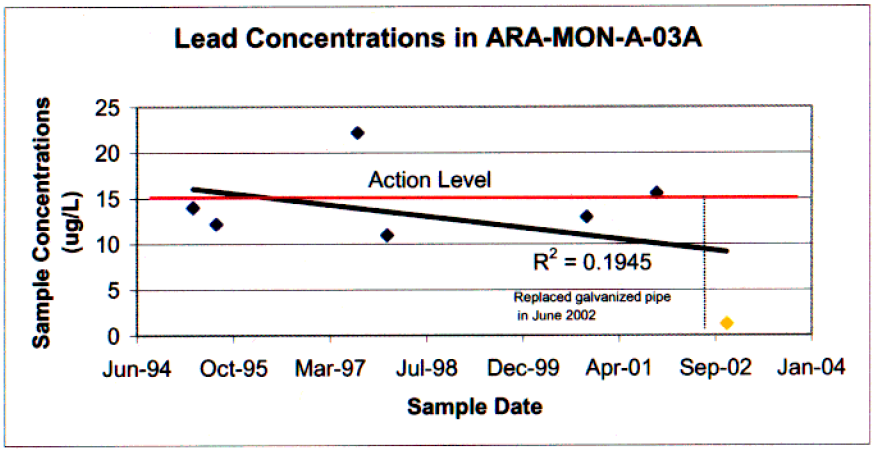
Appendix B

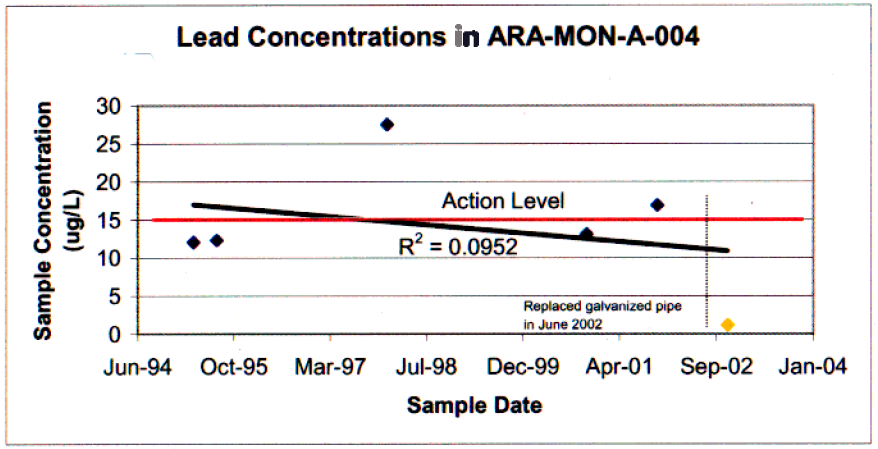
Lead Concentration Graphic Analyses

Appendix B
Lead Concentration Graphic Analyses



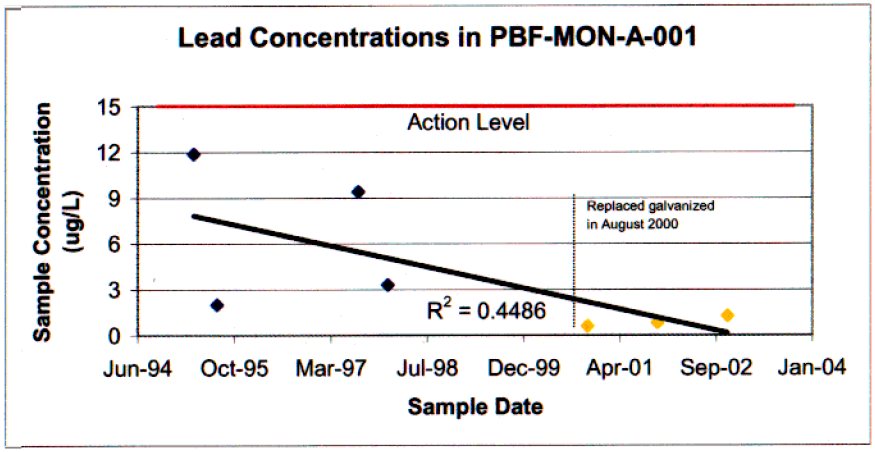


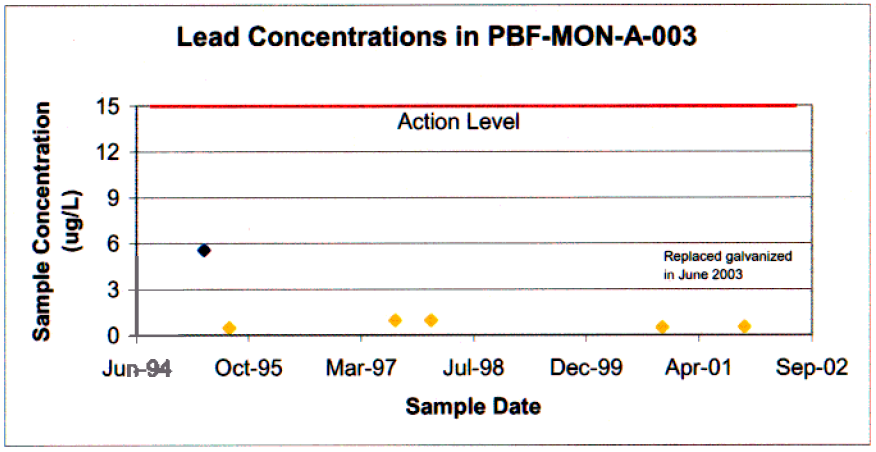


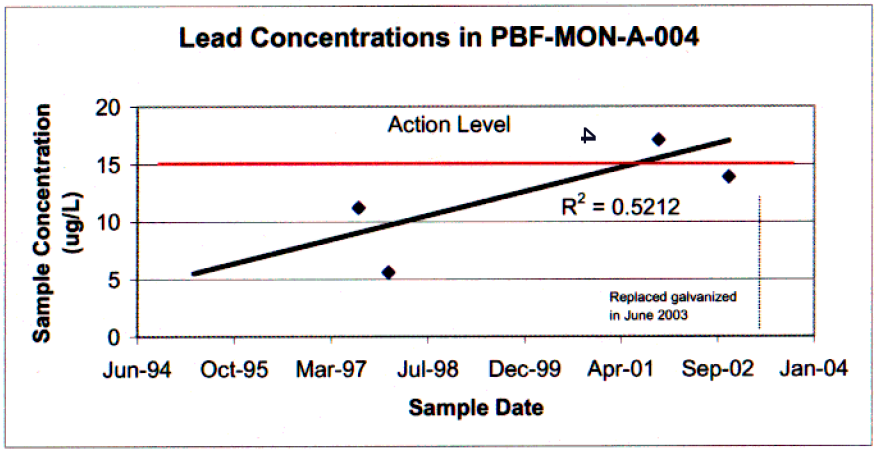


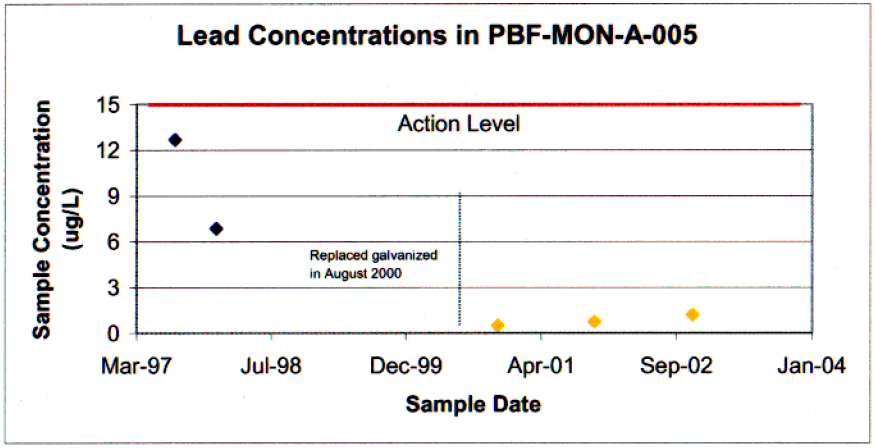
◆ = nondetections plotted at ½ the detection limit

◆ = detections



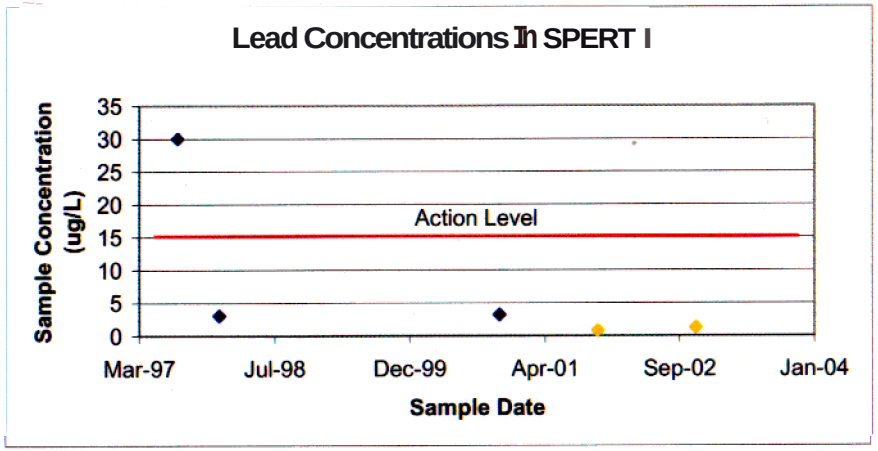






● = nondetections plotted at ½ the detection limit

♦ = detections



◆ = nondetections plotted at ½ the detection limit

◆ = detections

Appendix C

Quality Assurance/Quality Control Sample Results

Appendix C

Quality Assurance/Quality Control Sample Results

C-1. QUALITY ASSURANCE/QUALITY CONTROL SAMPLING

The purpose of collecting and analyzing quality assurance/quality control samples is to confirm the achievement of project objectives and data quality objectives. The overall objectives associated with the WAG 5 annual groundwater monitoring are discussed in the *Groundwater Monitoring Plan for the Waste Area Group 5, Remedial Action* (DOE-ID *2000).* The overall objectives and quality assurance or quality control sample results for the FY 2003 sampling effort are discussed in the following sections.

C-1.1 Precision and Accuracy

The spatial variations in the concentrations of contaminants at individual sites create sampling variability. Additional variability, called measurement error, occurs during sample collection, handling, processing, analysis, quality evaluation, and reporting. Concentrations of contaminants reported represent the true concentrations in the media sampled plus the measurement error, which can be minimized but not eliminated. Though it may not be significant in many cases, it is important to assess the contribution of measurement error to the total error in individual investigations. The analytical results of quality control samples are used to estimate accuracy and precision, the quantitative descriptions of measurement error, and bias.

C-1.1.1 Overall Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample collection procedures and by the natural heterogeneity of the matrix. Overall precision (field and laboratory) can be evaluated by the use of duplicate samples collected in the field. Greater precision typically is required for analytes with very low action levels that are close to background concentrations. Allowable laboratory precision for water samples is defined as having a relative percent difference (RPD) of less than or equal to 20%. Field precision is the difference between overall precision and laboratory precision. Table C-1 summarizes the precision for the FY 2003 round of groundwater monitoring. The RPD was calculated only for those samples that were true positive values for both the initial sample and the field duplicate. Using the formula

$$RPD = \frac{|S - D|}{S + D} \times 200 \qquad \text{(C-1)}$$

where

S = sample

D = duplicate.

As can be seen from the data in Table C-1, the RPD does not exceed 20% for any of the analytes; therefore, the overall precision of the FY 2003 data is considered acceptable.

Table C-1. Overall precision for FY 2003 analytical data.

Analyte	Sample	Duplicate	Units	RPD (%)
Arsenic	2.8	2.9	µg/L	3.5
Barium	40.4	39.8	µg/L	1.5
Chloride	17.8	17.8	mg/L	0
Fluoride	0.39	0.39	mg/L	0
Nitrate	1.1	1.1	mg/L	0
Sulfate	18.8	18.9	mg/L	0.5

C-1.1.2 Overall Accuracy

Accuracy is a measure of bias in a measurement system. Accuracy is affected by the methods used for sample preservation, sample handling, field contamination, and sample matrix. The effects of the first three are evaluated using the field blank, trip blank, and equipment rinsate results. The presence of a contaminant in the field blank, trip blank, or rinsate reveals that cross-contamination has occurred.

Laboratory accuracy is ensured through the use of standard methods and the use of calibration standards from the National Institute for Standards and Technology. All instrumentation is calibrated prior to use as per the procedures outlined in the analytical methods required by the INEEL Sample and Analysis Management (SAM) statements of work. Laboratory accuracy is assessed through the use of matrix spikes and laboratory control samples. The number of laboratory quality control samples is specified in the analytical methods employed and in the INEEL SAM statements of work. Evaluation criteria for the quality control samples are specified in data validation technical procedures administered by the INEEL SAM Office. For samples analyzed in accordance with EPA Contract Laboratory Program protocol, validation is performed in accordance with that protocol. For the FY 2003 data set, the overall accuracy of the analyses is acceptable.

C-1.1.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data accurately and precisely represent the characteristic of a population parameter being measured at a given sampling point or for a process or environmental condition. Representativeness is evaluated by determining whether measurements were made and physical samples collected in such a manner that the resulting data appropriately measure the media and phenomenon to be measured or studied.

For the FY 2003 sampling activity, all measurements were made according to established Environmental Protection Agency (EPA) and INEEL SAM protocol. The physical samples were collected by trained personnel using established INEEL procedures. The one difficulty encountered during the FY 2003 sampling event was that the detection limit and the EPA established MCL for 1-129 were the same (1pCi/L). However, for the FY 2003 sampling event a detection limit of < 0.5 pCi/L for 1-129 was required, ensuring that laboratory measurements are more representative of the groundwater quality at WAG 5.

C-1.1.4 Completeness

Completeness is a measure of the quantity of usable data collected during the field sampling activities. The Groundwater Monitoring Plan (DOE-ID 2000) requires an overall completeness goal of 90% for this project. For FY 2003, a total of nine wells were to be sampled with a total of 63 possible analyses (seven per well). However, the pump at well PBF-MON-A-003 failed to operate, consequently no samples were collected from the well during the FY 2003 sampling. As a result, 56 of the 63 possible analyses were completed resulting in a completeness of 89%. The pump at well PBF-MON-A-003 has been replaced, and is scheduled to be sampled again during the FY 2004 sampling event.

C-1.1.5 Comparability

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sampling designs. If sampling designs are not unbiased, the reasons for selecting another design should be well documented. Data comparability for this sampling activity was ensured through the following efforts:

- All data sets contained the same variables of interest
- All measurements have been performed and results reported using common units
- Similar analytical procedures and quality assurance measures have been used
- All field and laboratory instrumentation had similar or better detection limits than historically employed
- All samples were collected following established INEEL procedures
- Wells selected for sampling are identical to those historically chosen.

Samples were collected in the November timeframe, which was different from historical sampling rounds that occurred in April, July/August, October, and January. However, historical data collected at other sites at the INEEL indicate that contaminant concentrations are unaffected by seasonal factors. In an effort to negate any effect that changes in groundwater levels due to snow melt and runoff may have on data collected, this and future sampling rounds will be conducted at approximately the same time of year.

C-1.2 Data Validation

Method data validation is the process whereby analytical data are reviewed against set criteria to ensure that the results conform to the requirements of the analytical method and any other specified requirements. For the FY 2003 sampling activity, all laboratory data were validated according to established INEEL SAM and EPA protocols. The limitations and validation reports were previously transmitted to the Agencies in January 2003. No major problems were identified during this method validation process.

C-2. REFERENCE

DOE-ID, 2000, *Groundwater Monitoring Plan for the Waste Area Group 5, Remedial Action*, DOE/ID-10779, Rev. 0, **U.S.** Department of Energy Idaho Operations Office, DOE/ID-10779, Rev. 0, October 2000.